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BULLETIN OF THE GEORGIAN NATIONAL ACADEMY OF SCIENCES, vol. 2, no. 2, 2008

Human and Animal Physiology

About Possibility of Selective and Complete Paradoxical Sleep Deprivation with Nonpharmacological Method

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ABSTRACT. A new method of selective and complete paradoxical sleep deprivation (PSD) is proposed, involving the replacement of paradoxical sleep (PS) with episodes of wakefulness equivalent in duration. In contrast to the "classical" method of momentary awakening of the animal, the new method does not lead to: (1) the accumulation of a need for PS, associated with more frequent onsets of PS during deprivation; (2) PS rebound in the postdeprivation period; (3) increase in the rate of ponto-geniculo-occipital (PGO) spikes, rapid eye movements (REMs) and heart rate during PS phases in the postdeprivation period. The application of this selective and complete PSD technique does not cause noticeable changes in the learning processes, functional state and integrative activity of the brain; this guaranteeing its successful use for the treatment of some psychoneurological disturbances in clinics.

Key words: *paradoxical sleep, PS deprivation, accumulation, need for PS, wakefulness.*

In order to elucidate the functional significance of sleep a non-pharmacological method of its deprivation involving maintenance of prolonged waking state was used as early as in 1894 by Manacein [see 1]. For yet unknown causes the initial results seemed to be dramatic - under the activation of many day sleep deprivation the experimental dogs often died. Further investigations did not confirm a harmful effect of total sleep deprivation on animals, and the method of deprivation does remain the most effective in the study of sleep functions.

Research in this direction has been carried on with extreme intensity ever since it was established that sleeping state in terms of its neurophysiological parameters consists of two phases [2-6]: orthodoxal or slow-wave sleep (SWS) and paradoxical sleep (PS) or rapid eye movement REM one. The paradox of the latter lies in the fact that during it, against the background of deep behavioral sleep, brain structures (particularly the forebrain) are activated just like in the waking state [5, 7-9], thus creating an optimal background for the development of dreamings with their characteristic mental processes [3, 10]. As a rule, upon awakening from PS the subjects tell about the occurrence of dreams. It is just due to the mentioned peculiarities that PS phase has attracted special attention of researchers and numerous experiments have been devoted to the elucidation of its functional significance. Of major importance here was also the circumstance that non-pharmacological deprivation methods turned out to be most effective just with respect to PS phase. Momentary awakening of the sleeper leads to the cessation of this state and its transition to a more or less prolonged episode of wakefulness, followed by the restoration of SWS-PS cycle.

Therefore it is our firm conviction that an old "classical" method, involving PS interruption by behavioral awakening of the sleeper immediately at PS onset under the control of the experimenter, though being laborous, remains the most adequate for PSD. It found wide application in many laboratories all over the world [11, 12, 14, 15], including ours [16-19], and it has provided significant and valid findings, pointing to an important role of PS in the regulation of normal activity of the brain and the SWC as a whole.

Two findings should be singled out: 1. PSD by momentary behavior awakening immediately at the PS onset, that is there occurs sharp acceleration of PS onsets and, accordingly, an increase in the application of the arousing stimulus. 2. In the postdeprivation SWC there is a considerable increase in the number of PS phases per time unit, their mean duration, as well as in the intensity of each phase, expressed by the aggravation of all the neurophysiological parameters, characteristic of the brain state in the given phase. All this leading to the changes in the interrelations between SWC phases in favour of PS, and thereby to the disturbance of a normal structure of the SWC.

These two findings indicate the accumulation of specific need for PS resulting from the impossibility to satisfy it during deprivation, whereas in the postdeprivation period there occurs the satisfaction of PS need through its rebound.

As PSD is being already applied for clinical treatment of some psychoneurological disorders, causally related to the occurrence of this phase (endogenous depression, narcolepsy and others [20, 21, 15]), accumulation of specific PS need during its deprivation and increase of both intensity and duration of PS phases in the postdeprivation period undoubtedly restrict the practical worth of this method. It is obvious that whereas during the deprivation this procedure can have a positive effect, within the postdeprivation period due to the above-mentioned changes in PS parameters the effect can prove to be opposite.

This situation confronts the sleep investigators with the problem to find such non-pharmacological PSD method the application of which would not lead to substantial accumulation of PS need during deprivation and subsequently the disturbance of the normal structure of the SWC.

Accordingly, the question rises whether deprivation can be accomplished without the above consequences in selective and complete PSD.

We are optimistic in answering these questions positively, which is also supported by several early [22, 17-19, 23] mentioned facts:

1. The sequence of phases in the normal SWC has strong regularities - PS occurs against the background of SWS and not wakefulness; moreover, a certain duration of SWS is required in order to trigger PS [24-28]. However, in the course of normal SWC for some reasons a well-developed phase of SWS occasionally transfers to wakefulness phase rather than to PS and if the length of this wakefulness episode is approximately equivalent to the mean duration of PS in this animal, the latency to the subsequent PS onset is twice as long. Thus, the impression is created that the episode of wakefulness of a certain duration can replace PS phase.

2. The same regularity can be frequently observed during PSD by the method of momentary awakening. When animals are aroused from the emerging PS by means of awakening stimulus, at first naturally, a more or less prolonged episode of behavioral wakefulness occurs, after which SWS is restored and only then the subsequent PS is triggered. These wakefulness episodes are usually short (5-10 sec), but occasionally they can last some minutes. If the length of this wakefulness episode equals approximately the mean duration of PS phase in this animal, the occurrence of the next PS is postponed for the same time as if a full PS phase had occurred. Thus, in this case the impression is again created that equivalent-in-duration wakefulness episode can replace PS phase.

3. When for some reason, in the postdeprivation period a prolonged wakefulness phase at first develops, it considerably reduces PS rebound.

4. Our keen attention to the above facts has been apparently stimulated by the knowledge of the competitive relationship between wakefulness and PS, which is more or less evident under different conditions in the course of the SWC in the animals [29, 18]. Under the influence of the above mentioned facts the question arises as to whether the wakefulness episodes equivalent-in-duration to PS phases can replace them in the SWC so that neither accumulation of specific PS need during deprivation, nor PS rebound in the postdeprivation period occur.

To answer this question a series of experiments has been designed, which will be described below.

The experiments were conducted on 20 puberal cats (weighing 3-4 kg) divided into four groups (five animals in each). Every single group was subjected to PSD by means of "classical" method of momentary awakening at each PS onset [5] and a new method of replacing PS phases by wakefulness fragments of equal PS mean duration in the baseline SWC.

The groups of animals were distinguished in accordance with the duration of the deprivation procedures: in the first group it lasted for 12 hours, in the second -

24 hours, in the third - 48 hours and in the fourth one procedure took 72 hours. To each group of cats PSD of various duration through different methods was applied three times.

Steel electrodes were chronically implanted under Nembutal anesthesia (30-35 mg/kg) in various brain structures (neo- and archipaleocortex) and in cervical and oculomotor muscles for the polygraphic recording of the SWC, as well as in various nuclei of the hypothalamus and mesencephalic reticular formation (MRF) for stimulation; PGO spikes were recorded from lateral geniculate nucleus (LGN) of brain (Coordinates are taken from the atlas of Jasper and Ajmone-Marsan [30]). After a 5-8 day postoperative recovery period, experiments involving the monitoring (on a 16-channel EEG of the firm “Medicor”) of the SWC, and selective PSD were carried out in a special experimental chamber, where the acquisition of instrumental alimentary reflexes could be performed. Monopolar electroneocorticographic and electrohippocampographic recordings were obtained with an indifferent electrode placed either in the occipital bone of the skull or in the frontal sinus. An electromyogram and eye movement recordings were obtained via bipolar electrodes.

The schematic representation of the series of experiments with the application of selective PSD is shown in Fig. 1. The changes in the SWC structure under the action of I-selective PSD by momentary awakening (Fig. 1B) and II-selective PSD by awakening and further maintenance of wakefulness for a period equal to the mean duration of PS (Fig. 1C) were studied in the same chamber-adapted cats. The duration of fragments of evoked wakefulness was equal to the mean duration value of background PS phases (of about 8-10 minutes). Depending on the emotional tension of the induced wakefulness, the character of the mentioned state was determined by a behavioral reaction (attention and vigilance, in particular), as well as by the hippocampal theta rhythm that appeared in response to sensory stimuli or direct electrical stimulation of activating brain structures. Different levels of wakefulness could be characterized as “non-emotional” wakefulness, “active” wakefulness with a certain moderate emotionality and “emotional” wakefulness with expressed emotionality. Changes produced by these two PSD procedures in the SWC both during deprivation and postdeprivation period were compared with the baseline SWC (Fig. 1A). After the cessation of PSD of one or another duration via one or another method, the SWC was continuously recorded during 24 hours, and the registration of the cycle during further several days (3-4) was performed only in the daytime. It was possible, in that way, to determine the PSD aftereffects, as well as to compare the effect of different PSD procedures.

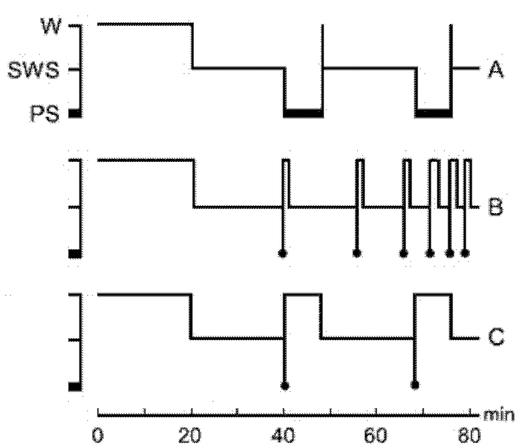

Fig. 1. Schematic representation of PSD experiments by various methods. Design of SWC structure during: A, baseline; B, PSD by “classical” method of momentary awakening; C, PSD by new method - through replacement of PS with fragments of wakefulness equivalent to baseline PS phases mean duration. Notation: W, wakefulness; SWS, slow wave sleep; PS, paradoxical sleep. Under design - the time scale in minutes.

It was borne in mind that the first series of experiments would demonstrate an accumulation of a need for PS during the period of its deprivation, which must be manifested in an acceleration of PS onsets and postdeprivation increase in its total amount. The second series of experiments was conducted to answer the question whether wakefulness episodes equal to mean PS duration are able to fully replace PS phases in the SWC. In addition, it was necessary to elucidate the character of the influence of selective PSD, employed in the above series of experiments on the functional state and integrative activity of the brain.

In order to define, via different methods, the effect of PSD on emotional-motivated behavior, the thresholds of electrical stimulation of ventromedial and lateral hypothalamus have been determined to induce orientation reaction as well as the reaction of anxiety, aggression, fear and alimentary behavior. CNS excitation under the influence of PSD was jugged on through one or another method in respect of the thresholds determination at the electrical stimulation of the dorsal hippocampus, indispensable to induce therein local epileptiform discharge in the process or after the termination of a special type deprivation, comparing them to those inducing the mentioned discharges before the deprivation procedures started.

Electrical stimulation of the brain structures (dorsal hippocampus, different areas of the hypothalamus and

MRF) was performed by bipolar electrodes with the help of rectangular electric impulses, applied from a high frequency generator output. The parameters (stimulus intensity, duration and frequency) appeared to be variable over a wide range (0.1 - 10 V; 0.5 - 5 msec; 0.2 - 500 Hz). High-frequency stimulation was used in order to obtain both isolated EEG activation and behavioral wakefulness.

The data were statistically treated. Mean values were calculated, their standard deviations and the validity of difference in the mentioned mean values were checked by Student's t-test.

During PS, the quantity of its phasic components was measured, in particular, PGO spikes and REMs (analysis epoch - 20 sec) as well as the rate of cardiac (heart) contractions (analysis epoch - 5 sec). These parameters were selectively calculated in number.

PSD was affected by awakening the animal following the transition of SWS into PS. The onset of PS was determined by the changes in the electric activity of the sensorimotor area of the neocortex, hippocampus, LGN and neck muscle as well as in eye movements.

At the termination of the experiments, the cats were sacrificed under Nembutal anesthesia, the brain was hardened by perfusion through the carotid artery with Neutral Formalin, removed and again placed in Formalin. The localization of the deep electrodes was verified on serial, 20-50 micron sections of the brain.

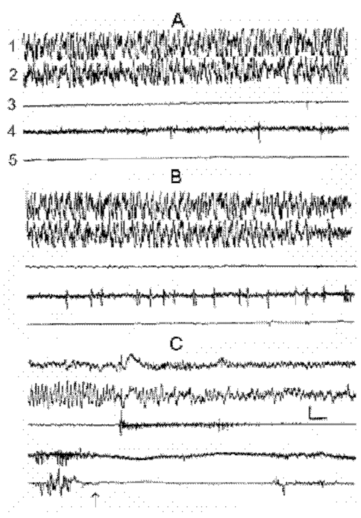

Fig. 2. Change of the electrical activity of the neo- and archipaleocortex, skeletal muscle tone and eye movements at PSD. A, DSWS; B, transition from DSWS to PS; C, PS and its deprivation through awakening in response to electrical stimulation of the lateral hypothalamus.
Leads: 1, sensorimotor area of neocortex; 2, dorsal hippocampus; 3, cervical muscle; 4, LGN; 5, oculomotor muscles. (the switch-on of electrical stimulation is indicated by the arrow). Calibration on this and Figure 3 is 200mV, 1 sec.

1. Changes in the polygraphic pattern of the SWC during deprivation

In the conventional experimental chamber, to which the animal is well adapted, the behavioral and EEG components of each phase develop synchronously. During DSWS, a usual precursor of PS, there occur slower and high-amplitude electric potentials both in the neocortex and in the hippocampus against the background of neck muscle atonia (as the animal is lying curled up, with its head on a firm support) and absence of REMs (Fig. 2A). Transition from SWS to PS is, as a rule, characterized by a more or less brief fragment, when the high-amplitude slow potentials are gradually suppressed in the neocortex as well as in the hippocampus (Fig. 2B – at the end of the recording). Following this fragment, in the hippocampus, there elaborates a theta rhythm, reaching its maximum value at the development of REMs (Fig. 2C – at the beginning of the recording). The very first evidence of the forthcoming PS onset are PGO spikes. They develop as single discharges even against the background of DSWS, with delta rhythm most of all expressed in the cortical structures (Fig. 2A). Later on PGO spikes, against the background of DSWS, become more frequent (Fig. 2B) and with PS onset start developing as group discharges (Fig. 2C). All these parameters indicate the valuable elaboration of PS development. If at this moment an applied sensory or direct electrical stimulation causes momentary awakening of the animal, a sharp suppression of the hippocampal theta rhythm, partial restoration of the skeletal tonus and disappearance of REMs and PGO spikes will constitute the most important polygraphic events (Fig. 2C). The heart rate does not undergo any considerable changes. After momentary awakening from the PS onset, the wakefulness fragment becomes typically short (within 10 sec) with following SWS restoration.

With the aim of further retention of wakefulness to replace PS repeated sensory stimuli or electric stimulation of activating brain structures have to be applied. Depending on the character of the enforced wakefulness, the electric activity of the hippocampus will be correspondingly affected. When "quiet" wakefulness is maintained, the theta rhythm is irregular, and in the case of "active" wakefulness a regular theta rhythm is observed. When "active" wakefulness with the manifestation of motivational behaviors (attention, alarm) is induced in response to the electric stimulation of the activating structures of the brain stem, the intensity of the hippocampal theta rhythm may reach the level characteristic of PS. Thus the two different types of PSD seem possible to be compared: by means of cessation of PS initial phases or/and momentary awakening in response to a single sensory or electrical stimulation of the activating structures of the brain (i.e. "classical" method), when the wakefulness fragment is characteristically short with subsequent rapid restoration of SWS; or through further preservation of wakefulness continuation within average duration of PS phase of the background SWC, i.e. when PS phases are replaced by wakefulness of equal to average value PS duration in the background cycles of the same animal.

A typical event during PSD by means of momentary awakenings is a gradual reduction of the latency of PS onsets. If, at the beginning, restoration of SWS is required for the subsequent PS onset, then, in the course of a long-term deprivation, PS is capable of appearing during the just restored LSWS, and even during "electroencephalographic" ("EEG") wakefulness. This leads to a sharp acceleration of PS onsets and, accordingly, to increased pairings of PS onset with the arousing stimulus.

A different picture is observed when the animal is aroused at the exact onset of PS, and wakefulness is enforced for the mean duration of PS, that is, PS phases are replaced with wakefulness. In this instance, acceleration of PS onsets - against the baseline cycle - is less pronounced than in the case of PSD by momentary awakenings, or is totally absent. The degree of this effect depends on the level of wakefulness produced. The enforcement of "non-emotional" wakefulness may result in a slightly increased frequency of PS onsets (Fig. 3C) as compared to the baseline (Fig. 3A), but significantly lower than during PSD by momentary awakening (Fig. 3B), whereas in the case of "active" and "emotional" wakefulness being induced, the number of PS episodes in the sleep-wakefulness cycle is well below (Fig. 3D, E) that seen in the baseline cycle (Fig. 3A).

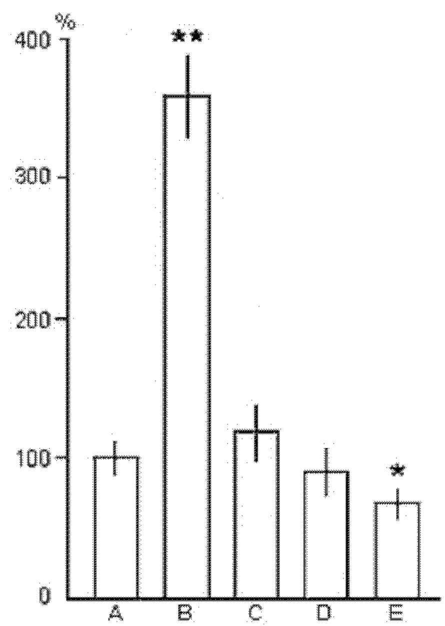

Fig. 3. The effect of PSD by various techniques on the frequency of PS phases onset during deprivation procedures.

On the ordinate: amount of PS onset in percentage. A, in the baseline (is taken as 100 %); B, at PSD with momentary awakening method; at PSD through replacement of PS by: C, "non-emotional", D, "active" and E, "emotional" wakefulness fragments.

(The significance of difference between: A and B: **P<0,01; A and E *P<0,05).

2. Changes in the structure of the postdeprivation SWC

More or less prolonged (12, 24, 48 and 72 hours) PSD by momentary awakening produces clear-cut quantitative changes in the PS frequency and duration, resulting in an increase in PS amount without marked changes of SWS. A selective PS rebound is particularly well seen within the first 6-8 hours following the cessation of the 24 hours deprivation procedure (Fig. 4B). Even after the cessation of a 72 hour deprivation procedure under the "classical" method, the PS rebound lasts merely within 6-8 hours, with the restoration of its background value after that. The recording made in subsequent several days demonstrated that PS rebound was not delayed, since it did not occur in the SWC, registered 24 hours after the termination of PSD. Against the background of PS rebound in the postdeprivation period the emerging PS phases are frequently interrupted due to a kind of self-deprivation. These self-deprivations at first terminate in behavioral arousal, but afterwards PS episodes may be interrupted without behavioral awakening. In the postdeprivation period brief PS episodes may occur and terminate during SWS without producing considerable electroneocorticogram desynchronization; thus, the impression is created that some PS components (hippocampal theta rhythm and eye movements in our case) may intrude upon SWS.

However, if PSD is conducted in such a way as to replace PS phases with wakefulness episodes, postdeprivation PS rebound is lesser or absent altogether and occasionally even a decrease in PS amount (Fig. 4E) is observed. This depends on the character of the wakefulness induced. A quiet "non-emotional" wakefulness being elicited, postdeprivation PS rebound decreases (Fig. 4C), compared with the "classical" method (Fig. 4B). If PS phases are replaced with episodes of "active" wakefulness (arousing stimulus-induced state of attention and vigilance), no increase in PS amount

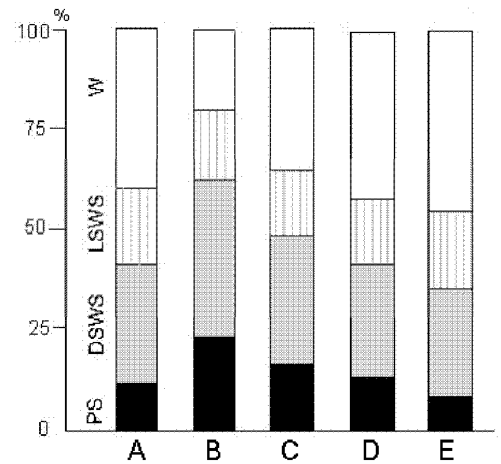

Fig. 4. The effect of PSD by various methods on the percentage ratio of different phases in a 8 hr postdeprivation SWC.
A, baseline ratio; B, following PSD by "classical" method; following PSD through PS replacement with fragments of: C, "non-emotional"; D, "active" and E, "emotional" wakefulness. (One of the typical results is presented).

(Fig. 4D) in the postdeprivation period is observed (compared with baseline (Fig. 4A)).

An analysis of the polygraphic patterns reveals other changes in the postdeprivation SWC. Thus, in the case of PSD by momentary awakening during a postdeprivation selective PS rebound there is a considerable increase in the heart rate (Fig. 5A, grey column), REMs (Fig. 5C, grey column) and PGO spikes (Fig. 5B,

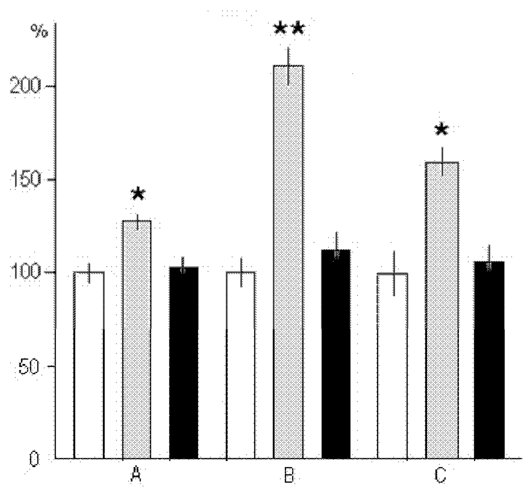

Fig. 5. The effect of PSD by various methods on the postdeprivation PS quality.
A, heart rate; B, PGO spikes; C, REMs. On the ordinate: amount of these parameters at PS in percentage. Light columns - in baseline (is taken as 100 %); grey columns - following PSD by "classical" method; black columns - following PSD through replacement of PS by "active" wakefulness. (*P<0,01, **P<0,001 compared with baseline)

grey column) as compared to the baseline patterns (Fig. 5A, B, C light columns). With the cessation of PS rebound the above components revert to the baseline values. The above postdeprivation alteration of the heart rate (Fig. 5A, black column), REMs (Fig. 5C, black column) and PGO spikes (Fig. 5B, black column) are absent when PS phases are replaced with "active" wakefulness fragments.

3. Changes in the excitability of various brain structures under the action of PSD

The excitability of extensive cortical and subcortical (hippocampus, hypothalamus, MRF and some others) brain structures was studied by determining the electrical stimulation thresholds evoking activation of the electroneocorticogram and electrohippocampogram during all the above deprivation manipulations. Account was also taken of the fact that in response to cortical and some subcortical stimulation diffuse activation of the electroneocorticogram can be produced by the excitation of nonspecific activating mesodiencephalic structures.

A careful comparison of the electric stimulation thresholds throughout 3-day PSD by "non-emotional" awakening and 24 hour postdeprivation period with those prior to the deprivation procedure showed that the excitability of most brain structures is not markedly affected under the action of PSD. Only a slight nonsignificant decrease in the thresholds of electric stimulation of the MRF (Fig. 6A) during the first postdeprivation hours - preferentially in PS - was observed, the same being revealed in the hippocampal theta rhythm changes.

No marked changes were observed in the thresholds, for epileptiform discharges evoked by direct electrical stimulation of the hippocampus either during prolonged PSD or in the postdeprivation period (Fig. 6B).

The analysis of data obtained shows that although the "classical" PSD procedure makes it possible to delay the development of full-fledged PS phases for a fairly long duration, during it there occurs an accumulation of an unsatisfied need for PS. This in turn leads to a sharp acceleration of PS onsets throughout deprivation and to selective rebound in the postdeprivation period. Moreover, due to accumulation of the need for PS there may also occur dissociative processes described in the literature [29] and allegedly indicative of the possible occurrence of some PS components in other phases of the SWC. In analyzing the dissociative aspects of selective PSD, one should apparently take into account the participation of the self-deprivation phenomenon [19] in these processes. The point is that self-deprivation of PS

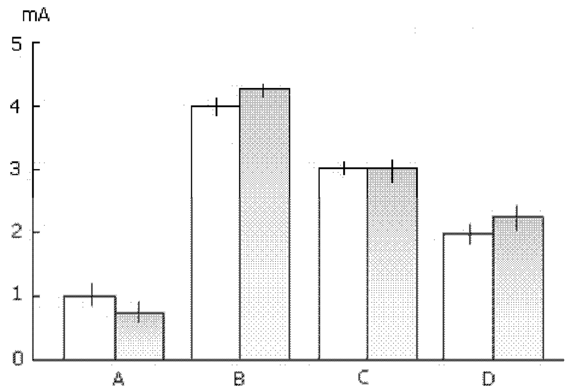

Fig. 6. The effect of a 3-day PSD through PS replacement with fragments of wakefulness against the thresholds of electrical stimulation of the MRF (A), dorsal hippocampus (B), ventromedial (C) and lateral (D) nucleus of the hypothalamus for evoking the orientation reaction, epileptiform discharges, aggressive and alimentary reaction correspondingly.
On the ordinate: power of electric stimulation in mA. Light columns - before deprivation procedure; grey columns - after cessation of PSD.

may occur without any clear-cut behavioral reactions. Occasionally even a genuine restoration of neck muscle tonus is absent. In such cases PS episodes can begin and cease both during slow electrical activity of the neocortex and during desynchronization of the electroneocorticogram. Hence a misleading impression is created of an isolated occurrence of PS components in other phases of the SWC.

Thus, arousing the animal at each onset of PS phase in the SWC by the so-called "classical" method does not ensure selective and complete PSD.

In contrast to the "classical" method, neither acceleration of the onsets of PS during its deprivation, nor selective PS rebound in the postdeprivation period are observed when PSD by replacing PS within the SWC with equivalent-in-time episodes of "active" wakefulness is used. There is no increase in the frequencies of PGO spikes, REMs and heart rate either. Moreover, no phenomenon of PS self-deprivation or dissociation of particular components of this physiological brain state, resulting in significant disturbances of a normal SWC, can be seen. All these findings indicate that selective and complete PSD can be accomplished only through PS replacement with equivalent-in-duration episodes of "active" wakefulness.

Of great importance for the elucidation of the functional significance of PS as well as for the assessment of PSD methods with regard to clinical practice is the circumstance that selective and complete PSD by replacement of PS with wakefulness does not induce considerable changes in the functional state and integrative activity of the brain. The absence of the negative effect of PSD by momentary awakening on the integrative activity of the brain may be explained by the fact that just then the mechanisms of PS continue working, at least, partly against the background of other phases (which is evidenced by the presence of dissociation process) and, thus, may accomplish their function in the sense of memory traces consolidation. However, such a conclusion seems to be hardly even possible in light of the results of the new method of PSD, since PS phasic components do not interfere with the other phases of sleep, which points, in this case, to the absence of PS mechanisms functioning.

In view of the foregoing, it seems waranted to conclude that:

1. Episodes of wakefulness (especially "active") replace PS phases and provide satisfaction of a need for PS;

2. Biological needs for PS and wakefulness might be identical in terms of neurochemical changes occurring in the brain during SWS. The last conclusion appears to be a most provocative speculation because, for the present, we may assume with certainty only the occurrence of a biological need for PS, and we have no data available for a biological need for wakefulness. But now reliable data on a biological need for wakefulness have been accumulated in our laboratory [31], which enable us to formulate the above assumption. The discussion of this problem raises another question: against the background of which phase of SWS should the biological need for PS be formed. In view of the above data the significance of wakefulness phase in this process is excluded, ascribing therefore much more importance to the meaning of SWS. It could be assumed that during the phase of wakefulness there takes place the formation of merely biological need for SWS, since both for PS and wakefulness the biological need is formed precisely at SWS [32]. Further experiments should be aimed at introducing more clarity to this question.

ადამიანისა და ცხოველთა ფიზიოლოგია

არაფარმაკოლოგიური მეთოდით პარადოქსული ძილის შერჩევითი და სრული დეპრივაციის შესაძლებლობის შესახებ

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შემუშავებულ იქნა ძილის პარადოქსული ფაზის შერჩევითი და სრული დეპრივაციის მეთოდი, რომელიც მდგომარეობს პარადოქსული ძილის შეცვლაში ეკვიფალენტური ხანგრძლივობის ღვიძილის ფრაგმენტებით. „კლასიკური", ცხოველის მომენტალური გაღვიძების მეთოდისაგან განსხვავებით, ახალი მეთოდის გამოყენებით (1) არ ხდება პარადოქსული ძილის მოთხოვნილების დაგროვება, რომელიც გამოწვეულია პარადოქსული ძილის ხშირი დაწყებით დეპრივაციის განმავლობაში; (2) არ ხდება პარადოქსული ძილის რებაუნდი პოსტდეპრივაციულ პერიოდში; (3) არ ხდება პონტო-გენიკულო-ოქციპიტალური სპაიკების, თვალის სწრაფი მოძრაობების და გულის ცემის სიხშირის გაზრდა პოსტდეპრივაციული პერიოდის პარადოქსული ძილის ეპიზოდების დროს. ამ, სრული და შერჩევითი პარადოქსული ძილის დეპრივაციის, ტექნიკის გამოყენება არ იწვევს დასწავლის პროცესის, ტვინის ფუნქციური მდგომარეობის და ინტეგრაციული მოქმედების შესამჩნევ ცვლილებებს. ამის გამო შესაძლებელია ამ მეთოდის წარმატებით გამოყება ზოგიერთი ფსიქონევროლოგიური დარღვევების მკურნალობის პროცესში.

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Received March, 2008